How do I become an engineer?

A bachelor's degree in an engineering program is required for most beginning jobs. Engineers trained in one branch will occasionally work in another branch when demand is high. Some engineers obtain master's and Ph.D. degrees to earn a promotion or keep up with new technologies. A Ph.D. is needed for most teaching and research positions and enables the highly motivated person to study and attain experience in areas where engineering and science overlap. Most engineering graduate students earn a salary by working with a professor on a research project, teaching an undergraduate class, or supervising a lab. Because of the demand for engineers, many companies offer funding programs and financial aid to employees seeking additional education.

It is possible to combine an undergraduate degree with advanced degrees in other fields. Many executives began their careers as engineers and later earned a master's degree in business administration (MBA). Other engineers obtain law degrees and specialize in areas of law relating to technology and patents.

College engineering programs for the bachelor's degree are solidly founded in mathematics and science. In a typical four-year curriculum, the first two years are spent studying basic sciences — math, chemistry, physics, introductory engineering, and the humanities. The last two years are spent studying one or more of the engineering specialties. Often students find that it takes five years to complete their bachelor's degree. Many colleges and universities offer five- or six-year cooperative education programs that provide experience and allow the student to earn a substantial part of her educational expenses. In such a program, a semester of full-time academic study alternates with a semester of full-time engineering-related work.

Students intending to study engineering should take as much mathematics and science (especially physics and chemistry) in high school as possible. Advanced mathematics classes offered in your high school would be particularly valuable. Courses in English and foreign languages are also important.

What/where are the jobs?

Engineers are in demand in the job market, and the outlook for jobs in the future is good. Engineers work wherever problems need to be solved, whether at a construction site, at a desk in an office, or in a research laboratory. Nearly half of all engineering jobs are in manufacturing industries, including microelectronics. Nonmanufacturing jobs are in engineering and architectural services, research and testing services, construction, and utilities. Other engineers work for government, mainly the federal government in the Departments of Defense, Transportation, Agriculture, Interior, and Energy and in the National Aeronautics and Space Administration (NASA). Some engineers are self-employed consultants, and others are entrepreneurs who start their own companies. Engineers work in large and small cities and in rural areas, and employment can be found in every state.

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For more information

Society of Women Engineers
345 East 47th St.
NY,NY 10017
www.swe.org

Center for Advancement of Hispanics in Science and Engineering Education http://cahsee.org/

The Society of Hispanic Professional Engineers http://shpe.wdi.net/

(original article by Delores Etter, 1984)

Engineering and Science Laboratory Technology

What is a lab technician?

A lab technician is someone who has learned the practical details and special techniques that are required in a modern scientific laboratory. Lab technicians can be found in such diverse fields as electronics, mechanics, biology, chemistry, and metallurgy. Computer technicians usually go to the computers rather than bringing them to a lab to work on.

Lab technicians generally work with scientists and engineers, running experiments, conducting research projects that can result in new ideas and expand our scientific knowledge, or running routine diagnostic samples. Thus, lab technicians contribute to the scientific teamwork responsible for the many new developments, products, and breakthroughs that are seen from day to day and taken for granted by all.

What makes a good lab technician?

To be a good lab technician certain qualities are needed. You should be able to work well with others. Many projects are worked on jointly by a group consisting of a project leader, often an engineer, and other lab technicians. You should be willing and able to voice your opinion and to volunteer your ideas to help the group meet its ultimate goal. You must also have the initiative to work on a project that might be assigned only to you. Determination and patience are often needed to meet schedules and solve problems that present obstacles. You should also have the patience to run the same or similar tests over and over again for routine samples.

What is life as a lab technician like?

What you do on the job depends greatly on your field of specialty. For example, if you are an electronics technician, you might take a circuit design, gather all the necessary components or parts, build the circuit, test it, and troubleshoot the circuit if it is not working. After the circuit works, you would do the necessary checkouts of the circuit—electrical continuity, environmental tests such as temperature cycling and air gun shock tests, and any required calibrations. A typical project for a mechanical technician might be to take a design for a scientific apparatus, prepare the necessary mechanical drawings, set up the apparatus, test to make sure it performs the required function, and make any needed modifications.

Research on a project can sometimes be long and tedious. But after the project is complete and you have achieved your goal, the feeling of satisfaction you have is very rewarding.

How do I become a lab technician?

Lab technicians in any field need at least a two-year associate degree and, increasingly, a bachelor's degree. Associate degrees are offered at many institutions such as junior colleges, community colleges, many four-year colleges, and private technical schools. To become a scientist or engineer, you almost always need a more advanced degree.

Northern New Mexico Community College offers a program sponsored by Intel to train wafer fabrication technicians. UNM-Los Alamos offers several programs to train chemical technicians, radiation control technicians, and others. The Technical Vocational Institute in Albuquerque has similar courses, as well as several to train hospital technicians, electronics technicians, and others.

Take as much mathematics as possible in both high school and in your further training. In order to solve many technical problems, advanced mathematics can be necessary. Computer science is also needed; the computer is very commonplace in scientific laboratories today as a tool in analyzing data, solving problems, or plotting graphs. Take science courses. These courses contain many of the basic theories you will need later to understand the research projects you are working on.

What/where are the jobs?

The demand for lab technicians is always increasing. Employment can be found in hospitals, food packing companies, and sanitation plants, as well as in private and government laboratories. The computer industry has created whole new categories of technician, such as wafer fabrication technicians, who are hired by chip manufacturing plants.

For more information

Contact the American Chemical Society Division of Chemical Technicians at

http://members.aol.com/ACSDoCT/techhome.htm

Here is one school's curriculum for training as a biological technician:

http://mauis.fhda.edu/FOOTHILL/divisions/Bio_and_Health/biotech/biotechhp.html

Center for Advancement of Hispanics in Science and Engineering Education http://cahsee.org

The Society of Hispanic Professional Engineers http://shpe.wdi.net/

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Environmental Science

What is an environmental scientist?

An environmental scientist works to prevent contamination of the environment. In some cases this means keeping contamination from reaching the environment in the first place, and in other cases it means cleaning up contamination that has been released to the environment. Just about every industry in the world creates waste products. Before there were laws and regulations governing the disposal of these waste products, the waste was disposed of in the environment—on land, in surface water, or in groundwater. In these old disposal areas, the waste products that could pose a risk to humans or to the plants and animals in the environment must be cleaned up. With the establishment of laws and regulations governing where waste products can be disposed of, most industries use environmental scientists to find ways to minimize and recycle the waste they produce.

What makes a good environmental scientist?

Good environmental scientists have a desire to clean the environment so that it is safe for people, animals, and plants to live in. In order to do this, environmental scientists must have a good understanding of one or more of the many branches of science (e.g., hydrology, chemistry, biology, toxicology, and engineering) that must be applied to the problems of cleaning up contaminants in the environment or preventing them from entering the environment. Because one person cannot be an expert in all of the sciences, a good environmental scientist must be able to work well in teams made of people with different backgrounds. They must also be able to communicate well, both in large and small groups and in written form.

Environmental scientists must enjoy working outdoors. Often this type of work requires collecting samples from the environment to test them for contamination. Depending on the specialty of the environmental scientist, she may have to collect samples (or observe or map) the soil, water, vegetation, or animals. Once the samples have been collected and the testing is done, the environmental scientist must analyze the information to decide how best to clean up the site. This analysis generally involves using computers to model or predict where the contamination will go.

Finally, a good environmental scientist must be able to understand the environmental laws and regulations, in particular, how they apply to the specific problem that is being worked on.

An environmental scientist, Kelly Bitner, is mapping the geographic formations in Utah. The mapping was important to deciding where to locate a disposal area for radioactive waste.

What is life as an environmental scientist like?

Environmental scientists generally have a good balance between outdoor work and office work. There is a great deal of satisfaction in collecting data and then analyzing it to develop conclusions based on scientific principles. This is particularly true when working in a team, where all the team members contribute ideas and perspectives from their own experience. This can be a very intellectually stimulating environment. The greatest feeling for an environmental scientist is finishing the cleanup of a contaminated site, knowing it is safe for people and the environment.

How do I become an environmental scientist?

Environmental scientists come from a broad range of educational backgrounds because it takes people from many scientific disciplines to figure out how to clean up a contaminated area. To become an environmental scientist, you should take as much math, science, and communication in high school as possible. Important areas to study are chemistry, physics, biology, trigonometry, algebra and calculus. In college, your undergraduate education should be broad and include some courses in many different sciences including geology, geography, computer science, engineering, technical writing, statistics, calculus, biological sciences, chemistry, and physics. A graduate degree is strongly recommended for environmental scientists, and during graduate studies is the time to choose a discipline to specialize in.

What/where are the jobs?

Environmental scientists work in both the private and public sectors. In the private sector there are consulting firms that contract with both industry and government to conduct environmental investigations and cleanup. Some private firms specialize in areas such as the cleanup of leaking underground storage tanks or cleaning up groundwater that is contaminated. In the public sector, there are jobs as regulators with cities (Albuquerque Environmental Health Department, the State (New Mexico Environment Department), or the Federal government (Environmental Protection Agency). The regulators watch over industry and contractors to make sure all their work is in compliance with laws and regulations. Other federal agencies, such as the Department of Energy or Department of Defense hire environmental scientists to mange the cleanup of contamination on their property.

An environmental scientist, Kelly Bitner, and assistants are collecting soil samples from a test pit. The soil samples were tested in the laboratory to estimate the age of the soil.

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For more information

U.S. Environmental Protection Agency
www.epa.gov
Careers in Environmental Research
Environmental Protection Agency
Policy and Research Division
Recruitment and Employment Program Branch
401 M Street
Washington DC 20460
202-260-4193
Order number EPA210K92009

New Mexico Hazardous Waste Management Society
P.O. Box 40353
Albuquerque, NM 87196

Academy of Certified Hazardous Materials Managers
P.O. Box 1216
Rockville, MD 20849
1-800-437-0137
http://www.achmm.org

Field Service Technology

What is a field service technician?

Just as people get sick, car engines develop knocks, and clothes washers leak, computer systems and other sophisticated business and scientific equipment occasionally break down. Repair of such systems is performed by the field service representative, who may be known as the field engineer, customer engineer, computer service technician, service representative, or "that gal/guy who fixes these things." The "things" that get fixed may be any part of the equipment such as, in the case of a data processing system, the computer itself or any number of related devices including magnetic tape and disc drives for memory storage, plotters for graphic representation, copiers and printers, and terminals that allow the operator to talk to the computer via a typewriter keyboard or TV screen. When the equipment breaks down, it is cheaper and easier to bring the technician to the site rather than transporting the unit to a repair center. The field service representative is thus a "doctor" who makes "house calls"; she diagnoses the problem and performs necessary repairs and adjustments. Installation of new equipment, modifications, updates, and routine preventive maintenance are also part of the job.

What makes a good field service technician?

A good field service technician must have two important skills. The first is technical knowledge. This would consist of a good base in electronics technology and the ability to think logically for troubleshooting problems. The electronics part is critical. You must have a good understanding of basic electronics theories, the proper use of measuring equipment, and the safe handling of electronic devices. The use of troubleshooting techniques and flow charts is also necessary. These are skills that can be acquired fairly easily by taking an electronics course at a vocational-technical school or college.

The second and equally important skill for a field service technician is customer relations. You will be going on-site to many different locations, with many different types of customers. Some are upset that their equipment broke down, and others are angry at you and your company. You must be able to handle both types. It is difficult not to throw anger right back at the customer; after all, you were not responsible for the breakdown of the equipment. You have to be able to listen to the customer's concerns and complaints while remaining calm. It takes a strong individual to take charge of a situation like this and to take the opportunity to turn an angry customer into a happy one. A customer skills workshop or course can help develop this ability.

What is the life of a field service technician like?

There is no "typical" day in the life of a field service technician. You do not go to an office at 8:00 a.m., sit at a desk or bench, take a lunch at noon, and leave at 5:00 p.m. The field service technician's job is different every day. One day might be spent at one customer site repairing one piece of equipment, and the next day a lot of travel may be involved, depending on the size of the territory for which you are responsible. Some techs may travel three or four hours and work on one piece of equipment, while others may work in just one city. Some techs are flown all over the country!

You could spend a day counting and restocking your parts inventory. Many companies have a lot of technical data to keep abreast of, so several hours a week may be spent on studying technical literature. The company also must keep you trained on new equipment, so you may spend a week in a formal classroom setting. The field service technician is rarely bored with the same old thing every day.

How do I become a field service technician?

There is no one path to follow, but a field service technician typically has two or more years of electronics technology. This may be acquired at a vocational-technical school, a community college, or a university. A two-year certificate or associate degree is common. You will have an easier time acquiring these if you buckle down in high school and take as much math and physical science as you can. Some of the math in electronics can be difficult without a good solid base of algebra for starters. It is also a good idea to have computer skills. Most electronic equipment today is computer-controlled, or it is hooked up to a computer. So, attain a working knowledge of a PC. You don't have to be an expert at the use of hand tools, but you must be able to learn their use. A tech's tool kit will contain screwdrivers, pliers, cutters, wire strippers, soldering irons, etc. All of these tools will be used in your electronics training, so you can build your skills from there. Some field service techs start out as bench technicians. A bench tech

works at a location where customers bring in broken equipment, and the tech repairs it at a repair depot. This allows you to develop your troubleshooting skills without a customer breathing down you neck. You can then move into the world of field service. There are many ways to get into field service, but the first step is always gaining technical knowledge.

If you are a girl who likes math and science, and you enjoy people, field service might be for you. Just because it seems like a man's job, it does not mean that you would not do well at it. Women can have a real advantage in this field. Their natural nurturing skills may come in handy when a customer is disappointed in piece of equipment. You can listen intently and show concern more easily than some men. If you approach it right, you can also have a calming effect on an angry customer. Women tend to be more thorough and patient. This will help you fix the problem right and prevent possible future problems. You also have a smaller build and smaller hands than a man, which will allow you to get to smaller parts without being "all thumbs." You may feel disadvantage where strength is concerned, but women are more likely to get help in lifting something without even asking for it. These may seem like small advantages, but they are real. Any woman who thinks she might like this type of career should not be afraid to enter this "man's field."

Where/what are the jobs?

There are many different types of field service jobs. The U.S. is full of them since we have a service economy, meaning many corporations are based on providing a service. Some techs will go to people's homes to repair washing machines, TVs and VCRs. Others might work on exercise equipment in gyms. Some will repair high-tech printers and plotters in offices. You might specialize in the repair of industrial equipment like conveyors, presses, or assemblers. Some companies do only field service work. They send their techs to many different training classes to allow them to work on many types of equipment. As you can see, there is about any type of work environment you might desire in field service.

A personal note

I was an honor student in school. I took many advanced math and science classes. When representatives from the area vocational-technical school came to talk to ninth and tenth graders, I decided to take electronics over the next two years. I was discouraged by teachers and counselors alike. They all said that I would do much better in regular classes. That just made me want it more! I took the two years of vocational-technical classes and was the only girl in my class of 35 students. It felt a little weird at first, but I really enjoyed it and I rose to the top of that class of boys. My efforts paid off with a college scholarship to a University's two-year program for an associate degree in electronics. I again encountered the same boy-to-girl ratio, but I remained confident. I graduated with honors, and I haven't looked back since. I have been working in field service since I was 20 yrs. old; I am now 31. I have more than doubled my salary in that time, and I am confident that I am one of the best field service technicians that my company has on staff. The moral to this story is not my accomplishments, but my determination. Had I listened to the counselors and teachers that told me not to take that first step into electronics, I would not have the satisfying career that I have today. Don't be afraid to take a path less traveled by women.

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Geology

What is a geologist?

A geologist is a scientist that studies the earth—its origin, history, and structure. The field of geology is very diverse, as diverse as the earth itself. The world we live on is a spectacular natural laboratory just waiting to be explored, its secrets discovered, and its processes understood. Geologists use their observations to form theories about how the earth works, how it is structured, and of what materials it is composed. Studying rocks and their minerals can tell us much about the history of the earth. Geologists collect information by drilling holes and by collecting rock and soil samples from the surface. They then examine these samples in great detail and try to recreate the events that lead to the rocks being formed and deposited.

There are many branches of geology and thus many types of geologists. There are mineralogists and petrologists who study minerals and rocks. There are geophysicists and geochemists who study the physical and chemical aspects of the earth and its rocks. There are seismologists and volcanologists who study and help predict earthquakes and volcanic eruptions. There are economic, exploration, mining, and petroleum geologists who help to find and develop natural resources such as precious metals and oil. There are hydrologists who study water flow and water conservation. There are geological engineers who advise construction engineers on the stability of dams, buildings, and highways. There are also paleontologists who study fossils, environmental geologists who work to understand and protect the environment, and even astrogeologists who study planets and moons. So you see that the sky is the limit when studying geology!

Student Marguerite Rodriguez during a field mapping exercise at a six-week field camp in White Mountains, CA.

What makes a good geologist?

To be a good geologist you must have good observation skills. This means being able to observe something and describe it in detail, in writing and verbally, so that you or others can use the information to draw conclusions. Being a good geologist also requires having the ability to take the information that you or someone else has collected and figure out the meaning of that information. You must be an "interpreter" of what the rocks tell you. It is sort of like being a private investigator: you must seek out clues and use the clues to solve some mystery.

Geologist Pam Pinson looks for copper minerals through a binocular microscope.

To be a good geologist, you must also love science in general. The field of geology is a combination of many sciences: earth science, physics, chemistry, biology, mathematics, and engineering. A basic understanding of all of these sciences is a must for a successful geologist. However, geologists also work with professionals in these fields so that when true expertise is needed, it is available.

Most of all a good geologist must love what she does. The satisfaction of working in her chosen area will give her the determination and motivation to be creative in her methods and thorough in her investigations. She should enjoy working independently and as part of a team. She should love the outdoors but not be intimidated by computers and other laboratory machinery. She should be in the field of geology for the love of it, not for the money.

What is life as a geologist like?

Depending on the specific branch of geology, a geologist may spend most of her time in the field or in the office. Most positions involve a

Geologist Pam Pinson and drillers at a drilling site.

balance of both. Life as a geologist can mean very long hours in the field collecting data. Many times deadlines on reports also require more than an eight-hour day. Geologists are professional scientists so they must often design their own study programs. This takes organization and foresight in planning. The program of study often involves collaboration with professionals from other fields. Geologists spend much of their time working with others but must also be able to work independently and trust their own knowledge.

Some branches of geology, such as exploration, mining and petroleum geology, volcanology, and environmental geology require that you travel and work on location. This may mean being away from home for months at a time or moving frequently. Keep in mind this possible demand for relocation when you are considering your career choice. Other positions, such as research or teaching positions or government or consulting jobs, may provide long-term stability in one location and require little or no travel. Most careers in geology do require some field work, even if it is just to stay in touch with the earth and to keep field skills sharp.

Geologist Marguerite Rodriguez analyzes a rock sample in a copper mine near a 56-cubic-yard shovel.

How do I become a geologist?

If you like rocks and minerals and you like the outdoors, you are well on your way to becoming a geologist already. To get a head start on college, you should try to take as many math and science courses as possible while in junior high and high school. You can also start learning about the rocks and minerals that you collect. Collecting rocks and minerals is a fun way to learn about geology.

Careers in geology require a bachelor's degree as a minimum (that's at least four years of college). Because there are so many specific fields of geology, however, it is very worthwhile to receive further education and get a masters degree or Ph.D. (that's anywhere from six to ten years of college but worth it!). During undergraduate education the required classes give you just the basics in all of the fields of geology. You do not really get into any specific subject in great detail unless you go to graduate school.

Geologist Marguerite Rodriguez mapping a mine bench face, looking for copper minerals at the Phelps Dodge Chino Mine.

In order to specialize in one of the specific fields of geology, you should continue your education after your bachelor's degree and pursue a master's degree. There you can decide what interests you most and study it in great detail, doing your own research and coming up with your own discoveries! This is a time of great learning. Obtaining a master's degree or Ph.D. in your area will help guarantee that you will find a professional position in your geological field of choice. A bachelor's degree is not worthless though. It can be more difficult to get into your favorite field, but it is not unusual. Many geologists with bachelor's degrees are top-notch in their fields. It takes a little more perseverance and study, but what can be learned in further schooling can often be learned on the job as well.

During your college education you will have a chance to learn about all of the basic sciences—math, chemistry, physics, biology, and engineering. Beginning classes of geology teach about the earth's processes, history, and place in the solar system. Next you will learn about the many different types of rocks and minerals and how geologists classify them. You will also learn about the structure of the earth and its physics and chemistry. Many of the classes have field exercises where you get a chance to get out of the classroom and do some hands-on field mapping and rock identification. Most universities also require a six-week field-camp course where you learn in detail the field methods required to be a geologist.

One good way to help you learn about what geologists do first-hand, and to help you gain valuable experience, is to work with geologists in a summer internship

program during your undergraduate years. Many mining and petroleum companies offer summer student employment. Check with your advisor and ask around in your geology department to learn about opportunities such as these. Career-related experience during college is the best thing you can have to increase your chances of finding a job when you graduate. You gain experience, exposure, and valuable contacts.

What/where are the jobs?

One of the most exciting and fun things about a career in geology is being able to travel and visit beautiful and exotic areas of the world. Geologists work on every continent and in every ocean. There are many possible types of careers and thus many types of job settings, from the research laboratory to the classroom, to the field.

Geologists work for many types of employers such as government agencies like the U.S. Geological Survey, mining and mineral exploration companies, petroleum companies, construction firms, colleges and universities, and research institutions. Some geologists are self-employed as private consultants. Geology provides a wide variety of opportunities in many locations; that's what makes it so inviting!

Marguerite Rodriguez, Geologist

505-536-3810

For more information

The U.S. Geological Survey Learning
http://www.usgs.gov/education/

Ask-A-Geologist
http://walrus.wr.usgs.gov/docs/ask-a-ge.html

American Geological Institute
4220 King Street
Alexandria, VA 22302-1507

Earth Science Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092

(original article by Georgianna E. Peña-Kues, 1984)

Health Physics/Radiation Protection

What is a Health Physicist?

Health physics is devoted to protecting people and the environment from radiation hazards, while making it possible to enjoy the benefits of the peaceful use of the atom. Health physics is diverse and one of the most interesting and rewarding fields of scientific endeavor. Many industries, medical facilities, national laboratories, and research laboratories demand professionals who understand radiation hazards and their prevention and control.

For decades, ionizing radiation has been used in beneficial ways, such as in medicine, treating cancer, irradiating food and medical wastes to destroy bacteria, and generating electrical power. But when used unsafely, ionizing radiation can harm living organisms. Care must be taken with nuclear reactors, high-energy particle accelerators, x-ray machines, and radionuclides used in biomedical research and therapy. Health physicists help minimize the potential for unnecessary irradiation of individuals or environmental contamination. Health physicists work in a variety of disciplines, including medicine, research, industry, education, environmental protection, and enforcement of government regulations. Although usually concentrating in one of these areas, a health physicist typically performs duties in several areas.

What Makes a Good Health Physicist?

A good health physicist needs to be able to draw from a wide variety of disciplines including physics, biology, biophysics, engineering (nuclear, civil, mechanical, or electrical), physiology, genetics, ecology, environmental sciences, toxicology, meteorology, and industrial hygiene. These disciplines must be integrated in an analytical fashion to solve specific problems. Although the health physicist may specialize, a professional health physicist typically performs duties in several areas. The wide spectrum of knowledge required of the health physicist makes this profession both challenging and rewarding.

What Is Life as a Health Physicist Like?

One of the advantages of health physics is that one may specialize in one or more of the following fields:

Health Physics Research: If involved in research, a health physicist may investigate the principles by which radiation interacts with matter and living systems. Health physicists also study environmental radioactivity and the effects of radiation on biological systems on earth and in space. This research is used in many ways, ranging from designing radiation detection instrumentation to establishing radiation protection standards.

Medical Health Physics: Those interested in medicine may choose to specialize in medical health physics. They work wherever radiation sources are used to diagnose and treat human diseases. Hospitals, clinics, and major medical centers use radiation sources, including x-ray machines, particle accelerators, and many types of radioactive materials. Medical health physicists are needed to ensure proper and safe working conditions for both patients and medical staff. Health physicists may assist physicians in setting up shielding for x-ray rooms, ensuring that machines are properly calibrated, assisting with treatment planning for radiation therapy, or ensuring radiation protection for diagnostic nuclear medicine departments. The medical health physicist may also teach courses in radiation physics and biology, and review research projects involving radiation work. Through her personal supervision of radiation installations in hospitals and clinics, the health physicist seeks to obtain the maximum benefits of nuclear medicine with minimum risks of radiation exposure.

Environmental Health Physics: The environmental health physicist is the professional most closely associated with protecting the public and environment from unnecessary exposure to manmade and technologically enhanced natural radioactivity. One important task is the environmental surveillance for radioactivity, which involves many types of instrumentation and field sampling technologies. Another typical area of responsibility is using computer models to assess the environmental impact of radionuclides released to the environment.

Industrial or Applied Health Physics: These health physicists advise managers regarding methods and equipment for radiation work. She also assists engineers and scientists in designing facilities and new radiation control programs.

Educational Health Physics: Those working in education develop and conduct training programs for future health physicists. They also train radiation workers and the general public. These individuals instruct workers and other health physicists regarding

the risk associated with radiation sources and methods used to reduce risk. One goal is to help individuals understand the relative risk of radiation exposure. In most cases, the risk is no greater than that found from other hazards in industries. Health physicists in education may be found in college or university classrooms and laboratories, or at off-campus training sites where they supervise student instruction. Sometimes educators conduct their own health physics research projects and publish their findings.

Regulatory Enforcement Health Physics: Those who work in regulatory enforcement must have knowledge and experience concerning all types of radiation hazards in order to establish guidelines for adequate radiation control. These guidelines help society receive the greatest benefits from radiation sources at the lowest possible risk.

Power Reactor Health Physics: A power reactor health physicist is responsible for all phases of radiation protection at a reactor site. Responsibilities may include selecting, purchasing, and maintaining radiation protection, laboratory, and detection equipment. Nuclear power plant workers require extensive training, while plant process systems require detailed study. The power reactor health physicist must be ready to respond quickly and with expertise in the unlikely event of a radiation accident. Health physicists make assessments of the potential environmental impact and ensure that the facility complies with federal regulations. Procedures must be prepared and updated, safety standards and emergency plans must be written, and preparedness drills conducted. It is common for a power reactor health physicist to supervise as many as 70-80 technicians and professionals, such as chemists and radiochemists. The daily work of a power reactor health physicist may involve reviewing radiological monitoring data for as many as 2000 employees. Area radiological surveys, radiation records, and internal and external measurements of radioactivity must be reviewed. In addition, survey and laboratory results are analyzed to ensure the reactor is operating within prescribed limits. The power reactor health physicist's career is multifaceted, satisfying, and rewarding.

How Do I Become a Health Physicist?

Because health physicists have responsible technical positions in several disciplines, you will need a broad background of education and experience. A bachelor's degree with basic education in the physical sciences is necessary, but training is also required in other areas, such as biology and math. In addition, most health physicists have a master's degree in health physics. A few go on to receive a Ph.D. in health physics. Academic programs in health physics, leading to baccalaureate and advanced degrees, are now offered in several American universities. These comprehensive programs will allow you to specialize in areas such as medical physics, biophysics, nuclear engineering, radiation biology.

Health Physics Technician: Opportunities also exist in the field for health physics technicians. The educational requirements are less than that for a health physicist; two-year associate's degrees in this specialty are offered by several schools. Academic training alone will not make a health physicist. Practical experience in applying radiation protection principles is essential. To provide hands-on, real-life experience, cooperative programs are offered at many universities in collaboration with national laboratories and utilities.

What/Where Are the Jobs?

Health physicists are in demand in the job market, and the outlook for jobs in the future is good. They work in research, industry, education, national laboratories, and government at most every level. Some health physicists are self-employed consultants, and others are entrepreneurs who start their own companies. Employment can be found in every state.

For more information

The Health Physics Society has a comprehensive Education Reference Book that describes the health physics academic programs and fellowships available in the US. If you would like to receive this book and additional information about scholarship programs, professional salary levels, and careers in health physics, please contact

http://www.hps.org
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Health Physics Society
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Hydrology

What is a hydrologist?

The job of the hydrologist is to solve problems of water quality, quantity, and availability. Hydrologists study all of the physical, chemical, and biological processes involving water as it travels its various paths over and beneath the earth's crust. Trained hydrologists may have a wide variety of job titles. Some specialize in the study of water in just one part of the hydrologic cycle: hydrometeorologists study water in the atmosphere, glaciologists study water and ice associated with glaciers, geomorphologists understand past water events from present landforms, geochemists study water quality, and hydrogeologists evaluate the effects of geologic conditions on water in the ground and on the land surface. Engineers who study hydrology include those in agricultural, civil, environmental, hydraulic, irrigation, and sanitary engineering.

What makes a good hydrologist?

Good hydrologists are curious about the past and intrigued by the possible developments of the future. They are trained to observe natural processes that may unfold over long periods of time, make notes of their observations, and analyze them critically. Hydrologists often love the outdoors and are drawn to their profession by a feeling of social responsibility or an environmental ethic. Many hydrologic studies now include scientists with expertise in other fields, so a hydrologist must have good communication skills and be able to work as a team member to solve problems.

Pedernales Falls, TX

What is life as a hydrologist like?

The work of hydrologists is as varied as the uses of water and may range from planning multimillion dollar interstate water projects to advising homeowners about backyard drainage problems and advising engineers on the construction of wetlands. Scientists and engineers working in hydrology may be involved in both field investigations and office work. In the field, they may collect physical data from rivers, streams, and wells; collect water samples and conduct tests of water quality; direct field crews; and work with heavy equipment and delicate monitoring devices. Many hydrology jobs require travel, some local, some abroad. A hydrologist's field sites may range from suburban yards to remote and rugged terrain accessed by helicopter. In the office, hydrologists interpret hydrologic data, write reports, and prepare oral presentations of results. Much of their work relies on computers for organizing, summarizing and analyzing masses of data, and for developing predictive models of phenomena such as river flooding, the consequences of reservoir releases, and the effect of leaking underground oil storage tanks on nearby ground water supplies.

How do I become a hydrologist?

Students who plan to become hydrologists need training in mathematics, statistics, geology, physics, computer science, chemistry and biology. In addition, some background in other subjects—economics, public finance, environmental law, government policy—can be useful for communicating with experts in those fields and to understand the implications of their work on hydrology. A hydrologist must learn to write clearly and concisely in order to communicate results to policymakers, regulators, other scientists, and the general public. Experience in public speaking is also useful to the hydrologist, who will often make public presentations to those audiences.

What/where are the jobs?

Hydrologists work both in research positions and applied areas wherever the availability, quality, or disposal of water is part of the task. Employers include a variety of federal agencies such as the Departments of Agriculture, Commerce, Defense, and Interior, and the Environmental Protection Agency. State and local governments also hire hydrolologists to help manage the use and preservation of water resources. Environmental consulting firms also provide many career opportunities for hydrologists, and university faculty not only conduct research but also teach new students.

Martha A. Hayes, Hydrologist, Baltimore, MD, E-mail: mahayes@ugs.gov

For more information

Refer to the U.S. Geological Survey's National Water Information Center http://water.usgs.gov/public/wrd005.html and the American Geophysical Union's hydrology section at http://www.agu.org.

Investment Analysis/Brokerage

What is an investment analyst?

You would find a job as an investment analyst, or stock broker, appealing if you like excitement and constant change. An investment analyst gathers pertinent facts on the past performance of management, markets, price/earnings ratios, etc., of companies, compares these facts to those of other companies in the same industry, and estimates a company's future performance. She educates clients on the whole realm of investments; hence, she must be fully informed about world and local political affairs as they relate to the financial world, and she must be able to present facts on more than 40 investment vehicles. Tax investment planning including real estate and oil and gas limited partnerships and estate planning can play an important role in her job. Basically, an analyst is an idea giver, fitting a client's needs and goals to particular investment vehicles, whether the client is an individual investor or a bank, a labor union, a teachers' pension fund, or a government agency.

What makes a good investment analyst?

An investment analyst must be able to read and digest a tremendous amount of information in order to determine whether a given product fits a customer's needs. She must be very self-motivated, have a high tolerance for stress, be basically optimistic, enjoy interacting with and selling to the public, and be able to keep accurate records of discussions and transactions with a client. She must be able to make decisions quickly and accurately; a good basic understanding of economics, mathematics, banking, and money markets contributes to the ability to make decisions effectively.

What is life as an investment analyst like?

It is difficult to imagine a job that is more difficult, exciting, hectic, frustrating, and rewarding. For example, as a fledgling stock broker you can spend 60—70 hours per week building up a clientele. Your day begins early, with a reading of current financial news (in the *Wall Street Journal*) and research comments to prepare for questions clients might have concerning financial investments. Once the financial markets open, a seemingly endless string of phone calls commences: client and broker make decisions and orders are entered. Dealing with problems that have come up and handling paperwork make up most of the remainder of the day.

How do I become an investment analyst?

A college degree in business and/or economics is helpful but unnecessary to be an analyst; nevertheless, it is increasingly important in the larger securities firms. Course work in math, economics, banking, marketing, speech communications, psychology, or sales is beneficial. If you become a broker, an in-house training period usually prepares you for the uniform National Association of Securities Dealers/Securities Exchange Commission examination required by the federal government. In addition, most states require a state examination in order to be licensed.

Where/what are the jobs?

Brokerage houses, trust departments at banks, investment divisions of insurance companies, and private investment advisor groups employ investment analysts. Analysts are also increasingly in demand in large corporations. Young women should seriously consider "Wall Street" as a career because firms are bending over backwards to comply with the regulations of the Equal Employment Opportunity Commission.

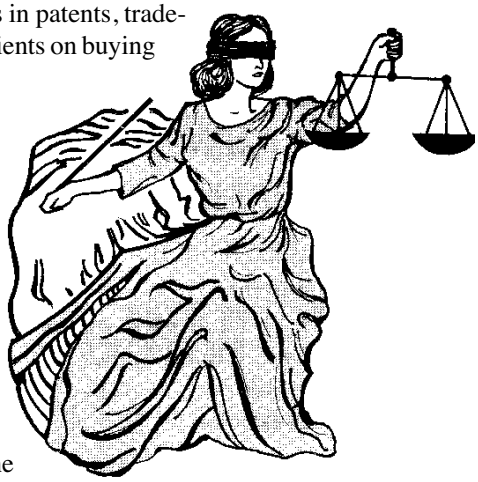
Linda Kay Thorne (1984)
Account Executive
Merrill Lynch
Pierce, Fenner & Smith
Albuquerque, NM

Law

What is a lawyer?

A lawyer helps others resolve legal disputes; that is, a lawyer has been trained to listen to a set of facts, to analyze those facts in order to identify the legal questions involved, and if asked, then to represent a client's interest. The resolution of a legal dispute can take place in a courtroom, or lawyers can negotiate and settle differences out of court. Also, a lawyer sometimes acts as a counselor and advisor in planning future conduct to avoid legal disputes.

Lawyers vary in the kinds of legal questions they handle. Some specialize in criminal law, representing clients accused of crime. Other lawyers specialize in tax law, giving advice about the wide variety of taxes collected by state and federal government. Intellectual property attorneys represent clients who wish to obtain or protect rights in patents, trademarks, copyrights, or trade secrets. Still others specialize in property law, advising clients on buying or selling a house or in estate law, making wills and trusts, for example.



What makes a good lawyer?

The same habits of mind and temperament that make a good professional also make a good lawyer. A lawyer, like a physicist, needs common sense, a good imagination, and a curiosity about the way people and things work. In law, however, some qualities of mind and temperament are uniquely important. First, you need to be careful. Much of law is tedious, detail can be significant, and all lawyer's jobs require preparation. You must be sufficiently conscientious to handle a lot of paperwork. Second, you need to be flexible. Often a problem cannot be resolved in the manner the lawyer first tries or even thinks is best. Lawyers need not only the imagination to conceive alternative resolutions but also the temperament to change approaches. Third, you need a tolerance for ambiguity. Sometimes there are no answers, and you must develop a solution or choose a course of action for a client that seems safe even though the legal ramifications are not entirely clear. Many people find this ambiguity exhilarating; some find it terribly frustrating.

Finally, a lawyer must be able to communicate easily and well in writing and in professional dialogue; she must be a good reader and a good listener. Not every lawyer, however, has to be a brilliant speaker. Effective speaking can be learned, and for most lawyers, written advocacy and face-to-face negotiation play a larger role than does argument in court.

What is life as a lawyer like?

Unlike the criminal defense lawyer Perry Mason, the average lawyer rarely goes to court but rather spends time doing research in a law library, talking to clients, and writing letters, legal arguments, or papers to be filed in court or an administrative agency. Much time is spent talking to other lawyers, either negotiating with an opponent or consulting with colleagues. Lawyers also participate in bar association activities or in community affairs, such as speaking to lay groups interested in legal issues. Many run for elective office or serve as judges.

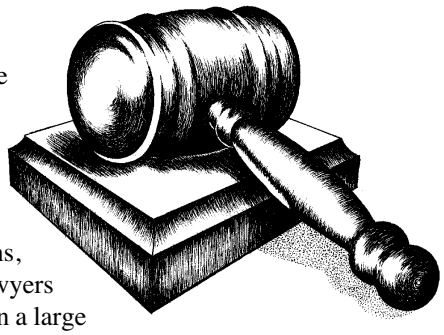
How do I become a lawyer?

To become a lawyer, you need a law degree, and you need to be admitted to practice law in a particular state. To become a patent attorney, you must also have a science or engineering background and be admitted to practice before the U.S. Patent and Trademark Office. Rules for admission to the Bar vary considerably from state to state, and admission to practice in one state does not automatically entitle a lawyer to practice elsewhere. Most states require a law school graduate to pass a bar examination before issuing a license to practice law.

Admission to law school usually requires a bachelor's degree, and the applicant almost always takes an aptitude test, the Law School Admission Test (LSAT), which does not require knowledge of the law.

The most worthwhile high school courses are those that develop skills in careful reading and exact writing. The development of skills and habits conducive to legal reasoning is more important than the subject matter. Take courses that develop a broad cultural background; the ability to organize materials and communicate results; habits of thoroughness, intellectual curiosity, and scholarship; and verbal skills. Courses in literature, language, speech, composition, and logic cultivate such skills. Questionnaires several years ago asked leaders of the Bench and Bar which prelaw college subjects they considered most valuable. The following subjects were listed, in order of preference: English language and literature, government, economics, American history, mathematics, English history, Latin, logic and the scientific method, and philosophy. Accounting (not bookkeeping) and public speaking were also recommended.

What/where are the jobs?



A law degree represents a very flexible career choice. Most attorneys are in private practice; many, including judges, are in government service; some are employed by private business; and the rest are in fields such as stock brokerage, banking, teaching, and politics. Several famous television journalists have law degrees.

Lawyers are distinguishable in terms of whether they represent individuals or institutions. Some work for the state, federal, or city government. Others work for corporations, such as General Motors or Exxon, as "in-house" counsel on a permanent basis. Lawyers who represent numerous clients are said to be "in private practice." They may work in a large firm of 100 lawyers or more, in cities such as New York, Dallas, or Chicago; as sole practitioners; or in a small or medium-sized firm. Albuquerque's largest private law firm employs about 50 lawyers.

There is no standard wisdom on where new openings are likely to occur. Certainly some of the largest cities seem to be, or to be rapidly becoming, "over-lawyered." New or migrating lawyers in growing areas like the Southwest, however, seem to find jobs with little difficulty. Income varies greatly with location, experience, area of specialization, and education.

Updated by

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(Original article by Pamela B. Minzner, Lawyer, Professor, The University of New Mexico School of Law, Albuquerque, NM)

Materials Science

What is a materials scientist?

Materials scientists and engineers work with the materials involved in manufacturing all products used in our society. These materials range from well-known metals that have been around for ages such as iron, tin, copper, and steel to many recently developed materials like polymers, ceramics, superconductors, and high-performance alloys. Materials scientists study how the properties of simple and complex materials can be controlled and modified by chemistry changes as well as by variations in processing. They also find ways to manufacture useful parts from these materials while maintaining the desired properties.

Materials science and engineering is important to our society. Many technological advances have happened because new materials were invented and/or better ways were found to manufacture existing materials. Automobiles are being manufactured to be lighter and more fuel-efficient and with more of their parts easily recyclable. Improvements in biomedical alloys have made implants that last longer, and they are more easily accepted by the body. The tiles on the space shuttle were specially designed to protect the shuttle during reentry and to be strong enough to withstand the forces of takeoffs and landings. New advances in plastics have made these materials very versatile and more directly recyclable.

What makes a good materials scientist?

A good materials scientist is curious about why materials perform the way they do and what can be done to make them better. Experiments play a big part in materials research so a good scientist should be able to run experiments accurately using many different types of equipment and to keep good, detailed records. Since materials science is a mix of chemistry and physics, interest in these subjects is a plus. Good communication skills are always necessary, and computer skills are becoming increasingly important.

What is life as an materials scientist like?

Life as a materials scientist can be varied. Some scientists work in laboratories using sophisticated equipment to fully analyze, test and develop new materials. Some scientists work mainly with small quantities of materials using microscopes and small testing equipment, while others may work with full factory setups making industrial products. Still other scientists may work in the field or in a manufacturing plant to solve problems. There only the experiments necessary to solve the problem are performed, and decisions are made quickly.

How do I become a materials scientist?

Materials science is a broad field that can accommodate many interests. To become a material scientist, you should take as much math and science in high school as possible. Be sure to study chemistry, physics, and math, such as trigonometry, algebra, and calculus. In college your undergraduate education should include chemistry, physics, calculus, and classes in the materials science field including microscopy, x-ray diffraction, heat, fluid and mass transport, and if desired, engineering. Courses in areas of specialization can be taken in graduate school to obtain M.S. and Ph.D degrees.

What/where are the jobs?

Many types of organizations employ materials scientists and engineers. Materials-producing industries such as metals, glass, ceramics, and plastics, and manufacturing industries like automotive, aircraft, electronic, and medical supplies are sources of employment. These can be large or small companies and are located all over the country. Universities and national laboratories are also good sources of employment. Since materials science is such a broad and necessary field, there is a great deal of diversity and options for employment.

Deniece Korzekwa, Materials Science Division, Los Alamos National Laboratory Email: deniece@lanl.gov

Mathematics

What is a mathematician?

A mathematician uses numbers and symbols in many ways, from creating new theories to translating scientific and technical problems into mathematical terms. Some mathematicians are more focused on pure mathematics. There are two types of developing mathematicians: the theoretical mathematician, who works with pure mathematics to develop and discover new mathematical principles and theories without regard to their possible application, and the applied mathematician, who uses mathematical methods to solve practical problems in such diverse areas as physics, astronomy, engineering, computer science, biology, ecology, medicine, economics, and or psychology. The pure or theoretical mathematician is more likely to teach and do research at universities or other research institutes, while the applied mathematician is likely to work for business, government or industry. Some mathematicians have their own consulting firms.

What makes a good mathematician?

"A mathematician who is not also something of a poet will never be a complete mathematician," according to Karl Weierstrass, a famous German mathematician. A mathematician appreciates beauty, symmetry, and order in nature and in logical and analytical thought. She should have a logical mind, a sense of curiosity, the desire and ability to solve problems, and numerical aptitude. A mathematician cannot be easily discouraged, for solving research problems often requires months of work. Some mathematical problems have remained unsolved for centuries. An applied mathematician must be able to communicate effectively and bring structure and analytical rigor to what is often a morass of confusing information. A mathematician, however, need not be a genius; a desire to work hard and an ability to formulate problems in mathematical terms is what makes a good mathematician.

What is life as a mathematician like?

A mathematician's life is spent learning and discovering new principles and using mathematics to formulate and solve problems. The tools of a mathematician, whether she teaches in a university or works in a laboratory, government, or private industry, are few in number: she needs a pencil (and an eraser!), paper, sometimes a computer or calculator, a good library, and professional colleagues. A mathematician rarely works completely alone. A theoretical mathematician will discuss new theories with co-workers and learn from their comments, and an applied mathematician will work closely with the scientists, engineers, or other clients, who need a mathematician to help solve problems in their fields. Besides communicating with co-workers and clients, a mathematician reads mathematical and scientific publications, attends national and international professional meetings here and abroad, gives presentation talks about her work based on her research, writes technical papers, and may teach. The love a mathematician has for her work and the satisfaction she derives from it make her professional life stimulating and rewarding.

How do I become a mathematician?

A future mathematician should take four years of mathematics in high school, including algebra, geometry, trigonometry, and analytic geometry, or precalculus (if it is offered, she should take calculus). In college, she should take many theoretical math courses (calculus, algebra, real and complex analysis, geometry, differential equations,), applied math courses devoted to problem solving (probability, statistics, numerical analysis, and computer science), and physical science courses (physics, chemistry, engineering.). To widen her career options, she should acquire a broad background not only in both pure and applied mathematics, but in the sciences such as physics, chemistry, engineering, and biology. College English composition classes are also invaluable; the ability to write clearly and correctly is essential in any profession.

A bachelor's degree with a major in mathematics is the minimum requirement for starting positions in mathematics. To advance to higher-level positions and do research or teach at the college level, a master's degree or a Ph.D. is necessary. Most mathematicians seeking advanced degrees decide in graduate school between pure and applied mathematics as their specialty.

Where/what are the jobs?

The college graduate with a bachelor's degree in mathematics can qualify for some positions in business, industry, government, and teaching. The opportunities and the pay increase significantly with higher degrees. Companies in the computer and communications industries employ many mathematicians as do oil companies, banks, consulting firms, and insurance companies. Almost